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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/811,442	03/26/2004	Liang Liu		1467

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WEI TE CHUNG
FOXCONN INTERNATIONAL, INC.
1650 MEMOREX DRIVE
SANTA CLARA, CA 95050

EXAMINER	
CANNING, ANTHONY J	
ART UNIT	**PAPER NUMBER**
2879	

DATE MAILED: 10/31/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

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Office Action Summary	Application No.	Applicant(s)
	10/811,442	LIU ET AL.
	Examiner	**Art Unit**
	Anthony J. Canning	2879

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08 August 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-9 and 11-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3-9 and 11-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Acknowledgement of Amendment

1. The amendment to the instant application was entered on 8 August 2006.

Double Patenting

2. Claims 16-20 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 2 and 9 of U.S. Patent No. 7,115,013. Although the conflicting claims are not identical, they are not patentably distinct from each other because:

Appl. No. 10/811,442	U.S. 7,115,013 B2
Claim 16. A method of making a CNT based field emission device, including the steps of: 1. Providing a working plate with a planar surface. 2. Depositing a catalyst layer on the working plate. 3. Growing CNTs from the catalyst layer, where the CNTs extend from the catalyst with flat roots. 4. Applying a cathode electrode to the tips of the CNTs. 5. Seperating the CNTs from the catalyst layer and exposing the flat roots, wherein the flat roots are configured to act as the electron emission ends of the CNT based emission device, providing gates beside the flat roots.	Claim 2. A method of making a CNT based field emission device, including the steps of 1. Providing a working plate with a planar surface (the insulative layer with a flatness less than 1 micron). 2. Depositing a catalyst layer on the working plate. 3. Growing CNTs from the catalyts with flat roots (flatness less than 1 micron). 4. Applying a cathode electrode to the tips of the CNTs. 5. Seperating the CNTs from the catalyst layer and exposing the flat roots (catalyst must be removed for CNTs to act as electron emitters) to act as electon emission ends of the CNT based emission device, providing gates next to the flat roots.
Claim 17. A method as in claim 16, further limited in that the gate electrode is supported by a barrier which is seated upon the cathode electrode.	Claim 2. A method of making a CNT based field emission device, wherein the gate is supported on the barrier which is supported on the cathode electrode.
Claim 18. A method as in claim 17, further limited in that the barrier has a common height with the CNTs measured from the cathode electrode.	Claim 9. A method of making a CNT based field emission device, wherein the barrier has a common height with the CNTs measured from the cathode electrode.

Claim 19. A method as in claim 16, further limited by the cathode being seated upon the barrier for applying the cathode to the tops after growth of the CNTs.	Claim 2. A method of making a CNT based field emission device, wherein the cathode is seated upon the barrier for applying the cathode to the tips after growth of the CNTs.
Claim 20. A method as in claim 16, further limited by the planar surface of the working plate having a flatness of less than one micron.	Claim 2. A method of making a CNT based field emission device, wherein the flatness of the working plate has a flatness of less than one micron.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1, 4, 7-9, 11, 14 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Han et al. (U.S. 6,515,415 B1) in view of Dai et al. (U.S. 6,232,706 B1).

5. As to claim 1, Han et al. disclose a carbon nanotube-based field emission device comprising: a cathode electrode (see Fig. 3, item 120; column 3, lines 54-57); and a carbon nanotube array of nanotube members, the carbon nanotube array of the nanotube members extending from a root end to a growth end, the carbon nanotube array being aligned perpendicularly from the cathode electrode (see Fig. 3, items 121; column 3, lines 54-57) and having a growth end embedded in the cathode electrode and an opposite root end (the end of the carbon nanotubes attached to the cathode is interpreted by the examiner as the growth end, and the end of the carbon nanotube that is not attached to the cathode as the root end); wherein the

growth end of the carbon nanotube array is in electrical contact with the cathode electrode (see Fig. 3, items 120 and 121; because the cathode and the carbon nanotubes are physically touching one another, and the highly conductive nature of nanotubes, they are in electrical contact with one another), and the root end defines a substantially planar surface (see Fig. 3, the root end of the carbon nanotubes are planar in the horizontal direction). Han et al. fail to disclose that the root end has a flatness of less than one micron across the nanotube array.

In the same field of endeavor, Dai et al. disclose a field emission device with a variation flatness of the planar surface less than 1 micron (column 3, lines 19-32; column 4, lines 11-15; here it says that the nanotubes can have a flat surface, which the examiner interprets to mean completely flat and therefore a variation less than 1 micron). Having uniformly flat nanotubes allows for desirable emission of electrons.

Therefore, it would have been obvious to one having ordinary skill in the art, at the time the invention was made, to modify the field emission device of Han et al. to include nanotubes with a variation in flatness of the planar surface is less than 1 micron, as taught by Dai et al., for the desirable emission of electrons.

6. As to claim 9, Han et al. disclose a carbon nanotube-based field emission device comprising: a carbon nanotube array which grows from a root end and extends to a growth end (see Fig. 3, items 121; column 3, lines 54-57; the end of the carbon nanotubes attached to the cathode is interpreted by the examiner as the growth end, and the end of the carbon nanotube that is not attached to the cathode as the root end); and a cathode electrode formed on and covering the growth end of the carbon nanotube array (see Fig. 3, item 120; column 3, lines 54-57); wherein the root end defines a substantially planar surface which is exposed outwardly and acts

as an emitter (column 4, lines 53-57), and the growth end is substantially embedded into the cathode electrode (see Fig. 3, items 120 and 121; because the cathode and the carbon nanotubes are physically touching one another, and the highly conductive nature of nanotubes, they are in electrical contact with one another). Han et al. fail to disclose that the root end has a flatness of less than one micron across the nanotube array.

In the same field of endeavor, Dai et al. disclose a field emission device with a variation flatness of the planar surface less than 1 micron (column 3, lines 19-32; column 4, lines 11-15; here it says that the nanotubes can have a flat surface, which the examiner interprets to mean completely flat and therefore a variation less than 1 micron). Having uniformly flat nanotubes allows for desirable emission of electrons.

Therefore, it would have been obvious to one having ordinary skill in the art, at the time the invention was made, to modify the field emission device of Han et al. to include nanotubes with a variation in flatness of the planar surface is less than 1 micron, as taught by Dai et al., for the desirable emission of electrons.

7. As to claims 4 and 11, Han et al. and Dai et al. disclose the field emission device as described in claims 1 and 9. Han et al. further disclose that the carbon nanotube array comprises a plurality of carbon nanotubes, each of which has an open tip (carbon nanotubes by definition are hollow carbon structures).

8. As to claim 7, Han et al. and Dai et al. disclose the field emission device as described in claim 1. Han et al. further disclose an insulative barrier having a height just exceeding the planar surface of the root end (see Fig. 3, item 130; column 1, lines 22-23) is formed adjacent the

carbon nanotube array and at least a gate electrode is formed on the barrier such that the gate electrode is separated from the cathode electrode (see Fig. 3, item 140; column 3, lines 58-59).

9. As to claim 8, Han et al. and Dai et al. disclose the field emission device as described in claim 7. Han et al. further disclose that the root end of the carbon nanotube array almost reaches the interface between the barrier and the gate electrode (see Fig. 3, items 121 and 130; since almost is a not any definite amount, the examiner interprets the height of the carbon nanotubes in the figure to be about the same height as the insulating barrier ribs).

10. As to claim 14, Han et al. and Dai et al. disclose the field emission device as described in claim 9. Han et al. further disclose at least a gate electrode is formed adjacent the carbon nanotube array at a height above the planar surface of the root end (see Fig. 3, item 140; column 3, lines 58-59).

11. As to claim 15, Han et al. and Dai et al. disclose the field emission device as described in claim 14. Han et al. further disclose the gate electrode is supported by an insulative barrier formed adjacent the carbon nanotube array (see Fig. 3, item 130; column 1, lines 22-23), such that the gate electrode is separated from the cathode electrode (see Fig. 3, items 121 and 140).

12. Claims 3, 5, 6, 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Han et al. (U.S. 6,515,415 B1) in view of Dai et al. (U.S. 6,232,706 B1) and in further view of Nakamoto (U.S. 6,097,138).

13. As to claim 3, Han et al. and Dai et al. disclose the field emission device as described in claim 1. Han et al. and Dai et al. fail to specifically disclose that the cathode electrode is made of copper.

In the same field of endeavor, Nakamoto discloses a field emission display, which has a cathode electrode, made of copper (column 4, lines 60-62). Copper makes ideal cathodes due to its conductive properties.

Therefore, it would have been obvious to one having ordinary skill in the art, at the time the invention was made, to modify the field emission device of Han et al. to include a copper cathode, as taught by Nakamoto, to take advantage of copper's ideal conductive properties.

14. As to claims 5, 6, 12, and 13, Han et al. and Dai et al. disclose the field emission device as described in claims 1 and 9. Han et al. and Dai et al. fail to specifically disclose that the height of the carbon nanotube array is in the range from 5 microns to 10 mm, more specifically between 10 to 500 microns.

In the same field of endeavor, Nakamoto discloses a field emission display with carbon nanotube emitters wherein the height of the carbon nanotube array is in the range from 5 microns to 10 mm, and more specifically between 10-500 microns (Abstract; given the aspect ratio is the height/diameter, one can calculate the height of the nanotubes, which falls within the given range). It is advantageous to have the nanotubes a certain height, with respect to their diameter, as to adjust the voltage applied to the nanotubes to have them emit electrons.

Therefore, it would have been obvious to one having ordinary skill in the art, at the time the invention was made, to modify the field emission device of Han et al. to include that the height of the carbon nanotube array is in the range from 5 microns to 10 mm, more specifically between 10 and 500 microns, as taught by Nakamoto, to be able to use the height of the nanotubes as a way to emit electrons at a desired voltage.

Response to Arguments

15. In light of the amendment of claim 16, a new double patenting rejection of claims 16-20 has been given.

16. Regarding the applicant's argument that the screen-printing method of Han et al. does not allow for a "growth end" or "root end", the examiner respectfully disagrees. The device of Han has carbon nanotubes, with an end attached to the cathode, which the examiner has interpreted as the growth end. The free end of the carbon nanotubes, from which electrons are emitted, the examiner has interpreted as the root end.

17. Regarding the applicant's argument that the carbon nanotubes are not embedded in the cathode, the examiner respectfully disagrees. Having the CNTs attached to the cathode is a form of embedding.

18. Regarding the applicant's argument that the carbon nanotubes do not have a flatness of less than one micron, the examiner respectfully disagrees. Dai et al. specifically states that the emission end of the CNT bundles can have a flat surface (column 3, lines 24-26), the examiner has interpreted flat to mean a flatness of less than one micron.

Contact Information

19. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anthony J. Canning whose telephone number is (571)-272-2486. The examiner can normally be reached on M-F 8:00-4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nimesh D. Patel can be reached on (571)-272-2457. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Anthony Canning AC
26 October 2006

K Guharay
10/26/06

KARABI GUHARAY
PRIMARY EXAMINER